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(54) **Polarizing color filter**

Polarisierender Farbfilter

Filtre couleur polarisant

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- **PATENT ABSTRACTS OF JAPAN vol. 14, no. 185 (P-1036) 13 April 1990 & JP-A-02 032 303 (NIPPON KAYAKU) 2 February 1990**
- **PATENT ABSTRACTS OF JAPAN vol. 9, no. 30 (P-333) 8 February 1985 & JP-A-59 172 610 (NITTO DENKI KOGYO) 29 September 1984**
- **DATABASE WPI Section Ch, Week 8715, Derwent Publications Ltd., London, GB; Class A05, AN 87-105939 & JP-A-62 054 201 (MITSUBISHI CHEM IND) 9 March 1987**

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Description

The present invention relates to a color filter capable of polarizing light, e.g. for use in display apparatuses such as a liquid crystal projection television set, overhead display, color projector and the like.

In a conventional liquid crystal projection TV set, two kinds of films, i.e., a color filter and a polarizing film, have been used as components of the TV set. The combined use of these two kinds of films has had problems such as reduction in transmittance owing to the light scattering between the films. Further, with this conventional technique, the combination has provided a poor polarizing ability so that high contrast images could not be obtained.

The assembly of color filters and polarizing films used in a conventional liquid crystal projector is shown in Fig. 1. It comprises red, green and blue color filters, two neutral polarizing films for each color filter and a liquid crystal cell for each color filter. Each of the neutral polarizing films ordinarily used gives a single plate transmittance of from 40% to 50%. Therefore the use of two such polarizing films gives a transmittance of as low as about 25% or below; therefore, a strong light source has been necessary to project a clear image.

EP-A-0182632 discloses a polarizing film which is a uniaxially stretched polymer film with two dichroic dyes adsorbed and oriented therein. It is neutral grey.

It would be advantageous to provide a polarizing color filter which was excellent in transmittance and durability, for use as a material for use in liquid crystal projection TV sets in which a color filter and a polarising film are separately used in a conventional technique.

The present inventors made extensive study of the above-mentioned situation and, as a result, found a polarising color filter of excellent transmittance and durability.

The present invention is directed to a color filter having a capability to polarize light, which comprises a dye having a spectral transmittance ("transmittance dye"), a dichroic dye having a capability to polarize light, and a base resin, wherein the combination of the transmittance dye and the dichroic dye is such that (1) the transmittance dye is red and the dichroic dye is blue, (2) the transmittance dye is green and the dichroic dye is red, or (3) the transmittance dye is blue and the dichroic dye is yellow.

It further relates to processes for producing the color filter as defined in claims 3-6.

A preferred embodiment may provide a color filter having an excellent transmittance and an excellent polarizing power, and, when used in a display apparatus, giving high contrast images.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a conceptional view showing a typical combination of color filters and polarizing films used in conventional liquid crystal projectors.

Fig. 2 is a spectral transmittance curve of a dye for use in red color filter.

Fig. 3 is a spectral transmittance curve of a blue dichroic dye measured when a monochromatic polarizing film containing the dye is overlapped by a neutral polarizing film with the polarization axes of the films at a right angle.

Fig. 4 is a spectral transmittance curve of a dye for use in green color filter.

Fig. 5 is a spectral transmittance curve of a red dichroic dye measured when a monochromatic polarizing film containing the dye is overlapped by a neutral polarizing film with the polarization axes of the films at a right angle.

Fig. 6 is a spectral transmittance curve of a dye for use in blue color filter.

Fig. 7 is a spectral transmittance curve of a yellow dichroic dye measured when a monochromatic polarizing film containing the dye is overlapped by a neutral polarizing film with the polarization axes of the films at a right angle.

The present color filter having a capability to polarize ("polarizing filter") comprises, in combination, a dye having a spectral transmittance ("transmittance dye"), and a dichroic dye corresponding thereto. Specifically, it is a single polarizing filter which is a combination of a polarizing yellow dichroic dye and a blue transmittance dye or a combination of a polarizing red dichroic dye and a green transmittance dye or a combination of a polarizing blue dichroic dye and a red transmittance dye.

As mentioned previously, in conventional liquid crystal projectors, there are used, to project a full-colored image on a screen, red, green and blue color filters, two neutral polarizing films for each color filter and a liquid crystal cell for each color filter. The combined use of these two kinds of films, i.e., color filters and polarizing films, has had problems such as reduction in transmittance owing to the light scattering between the films. Further, with this conventional technique, the combination has provide a poor polarizing power so that high contrast image could not be obtained.

In contrast, a preferred embodiment of the present invention is a single film having two functions, i.e.-, a color filter function and a polarizing ability. As a result, such a color filter may give excellent light transmittance, lead to no reduction in polarizing light due to light scattering, and provide excellent workability in assembling of a liquid crystal projection Tv set because it is a single film; thus, it is an excellent material for use in the liquid crystal projection TV set.

In the present invention, the transmittance dye may comprise one or more of cyanine type dyes, phthalocyanine type dyes, anthraquinone type dyes, azo type dyes, quinophthalone type dyes, perylene type dyes and cumarin type

dyes. There can be used any known dye, with no particular restriction. Preferably the dye shows, in the visible light region of 400-700 nm, the following wavelength characteristic and a dichroic ratio at the maximum absorption wavelength, of 5 or less, preferably 2 or less. That is, said dye is preferably:

(A) a red dye for use in a color filter, giving a transmittance at 610 nm, of 50% or more when the transmittance at 590 nm is 10% or less,
(B) a green dye for use in a color filter, showing the maximum transmittance at 550±20 nm and giving the maximum transmittance of 50% or more when the transmittance at the maximum transmittance wavelength ± 50 nm is 20% or less, or
(C) a blue dye for use in a color filter, showing the maximum transmittance at 450±20 nm and giving the maximum transmittance of 50% or more when the transmittance at the maximum transmittance wavelength ± 50 nm is 20% or less.

The dichroic dye used in the present invention may comprise one or more of anthraquinone type dyes, azo type dyes, quinophthalone type dyes, perylene type dyes and cumarin type dyes. There can be used any known dichroic dye, with no particular restriction. Preferably the dichroic dye is such that when a monochromatic polarizing film containing the dye is overlapped with a neutral polarizing film, the polarization axes being at a right angle, the dye shows, in the visible light region of 400-700 nm, the following wavelength characteristic and a dichroic ratio at the maximum absorption wavelength, of 6 or more, preferably 10 or more. That is, said dye is preferably:

(D) a yellow dichroic dye having a main absorption wavelength band at 400-500 nm,
(E) a red dichroic dye having a main absorption wavelength band at 500-600 nm, or
(F) a blue dichroic dye having a main absorption wavelength band at 600-700 nm.

Spectral characteristics of such dyes are shown in Figs. 2 to 7. Suitable combinations of a transmittance dye and a dichroic dye for use in a polarizing color filter embodying the invention include:

(1) a combination of a red dye giving a spectral transmittance curve of Fig. 2, i.e., dye (A) and a blue dichroic dye giving a spectral transmittance curve of Fig. 3, i.e., dye (F),
(2) a combination of a green dye giving a spectral transmittance curve of Fig. 4, i.e., dye (B) and a red dichroic dye giving a spectral transmittance curve of Fig. 5, i.e., dye (E), or
(3) a combination of a blue dye giving a spectral transmittance curve of Fig. 6, i.e., dye (C) and a yellow dichroic dye giving a spectral transmittance curve of Fig. 7, i.e., dye (D).

The working principle of the present color filter is explained for a polarizing color filter employing the above combination (1), i.e., a combination of a red dye suitable for a color filter and a blue dichroic dye. When, in Fig. 1, the red color filter and the neutral polarizing film-1 are replaced by a single color filter having a polarizing ability, employing the combination (1) and when a light from a light source is passed through the color filter and the resulting polarized light of 600-700 nm is transmitted through the liquid crystal cell and the neutral polarizing film-2, a red image is formed on the screen; while, when the light is absorbed, no image is formed on the screen. The same principle applies also to a color filter employing the combination (2), i.e., a combination of a green dye suitable for a color filter and a red dichroic dye, or a color filter employing the combination (3), i.e., a combination of a blue dye suitable for a color filter and a yellow dichroic dye.

The process of the present invention for producing a polarizing color filter includes various processes such as the following:

(1) a process (hereinafter referred to as the first process) which comprises coating and fixing a transmittance dye suitable for use in a color filter on a monochromatic polarizing film comprising a dichroic dye appropriate to said transmittance dye (for example, coating a blue, green or red transmittance dye on a yellow (for the blue dye), red (for the green dye) or blue (for the red dye) polarizing film);
(2) a process (hereinafter referred to as the second process) which comprises mixing a blue transmittance dye suitable for a color filter, a yellow dichroic dye and a resin, subjecting the mixture to melt extrusion to obtain a film, and subjecting the film to monoaxial stretching to produce a blue filter; and equivalent processes using a green transmittance dye and a red dichroic dye, or a red transmittance dye and a blue dichroic dye;
(3) a process (hereinafter referred to as the third process) which comprises dyeing a substrate resin film with a blue transmittance dye suitable for a color filter and a yellow dichroic dye and subjecting the dyed film to monoaxial stretching to produce a blue filter; and equivalent processes using a green transmittance dye and a red dichroic dye; or a red transmittance dye and a blue dichroic dye and subjecting the dyed film to monoaxial stretching to

produce a red filter; and (4) a process (hereinafter referred to as the fourth process) which comprises dyeing a monoaxial stretched resin, in an aqueous or organic solvent-based dyeing bath, with a mixed dye solution containing a blue transmittance dye suitable for a color filter and a yellow dichroic dye to produce a blue filter, or with a mixed dye solution containing a green transmittance dye suitable for a color filter and a red dichroic dye to produce a green filter, or with a mixed dye solution containing a red transmittance dye suitable for a color filter and a blue dichroic dye to produce a red filter.

In the present invention, the resin used in the color filter may be any resin as long as it is transparent and is easily oriented by monoaxial stretching. It includes polyethylene terephthalate (PET), polybutylene terephthalate (PBT), polyethylene naphthalate (PEN), and polyvinyl alcohol (PVA).

The first process for producing the present color filter, which comprises coating the transmittance dye or a mixture thereof onto the monochromatic polarizing film, may be conducted as follows:

First, the production of the monochromatic polarizing film may be conducted by the following processes, as described in, for example, Japanese Patent Application Kokai (Laid-open) Nos. 270664/1987 (USP 5,059,356) and 275163/1987 (USP 4,824,882):

(a) a process which comprises mixing pellets of a transparent resin with a dichroic dye, subjecting the mixture to melt extrusion to produce a material film, and stretching the film monoaxially 3- to 10-fold at about the glass transition temperature (Tg) of the resin,
(b) a process which comprises dyeing a transparent resin film in a dyeing bath containing a dichroic dye and then subjecting the dyed film to monoaxial stretching at about the glass transition temperature (Tg) of the resin, and
(c) a process which comprises stretching a transparent resin monoaxially at the glass transition temperature (Tg) and then dyeing the stretched resin in a dyeing bath containing a dichroic dye.

The above-produced polarizing film may be coated with a dye as follows: A dye for a color filter may be dissolved in a single or mixed solvent selected from aliphatic hydrocarbons such as octane, hexane, cyclohexane, dimethylcyclohexane and ethylcyclohexane, aromatic hydrocarbons such as toluene and xylene, halogen-containing solvents such as chloroform and trichloroethane, ethers such as tetrahydrofuran and dioxane, alcohols such as ethanol, methanol, ethylene glycol methyl ether (trade name: METHYL CELLOSOLVE), ethylene glycol ethyl ether (trade name: ETHYL CELLOSOLVE), ethylene glycol propyl ether (trade name: PROPYL CELLOSOLVE), ethylene glycol butyl ether (trade name: BUTYL CELLOSOLVE) and hexafluoroisopropanol, ketones such as acetone, fluoroacetone, cyclohexanone, methyl ethyl ketone and methyl butyl ketone, and esters such as ethyl acetate, butyl acetate, methyl cellosolve acetate, ethyl cellosolve acetate, propyl cellosolve acetate and butyl cellosolve acetate; the resulting solution is coated onto the polarizing film by spin-coating, dip coating or the like; and the resulting film is dried at a temperature from room temperature to 100°C to obtain a polarizing filter.

The second process for producing the present color filter, which comprises mixing a substrate resin, a dichroic dye and a transmittance dye and then subjecting the mixture to stretching, is suitable conducted as follows: Two dyes and a resin are mixed at a temperature higher than the melting point of the resin; the mixture is subjected to melt extrusion to prepare a material film; and the film is stretched by the method mentioned in the first process. Alternatively, two dyes and a resin are dissolved in a solvent; a cast film is prepared from the solution; and the film is stretched by the method mentioned in the first process. Thus, a polarizing color filter is obtained.

In the third process for producing a polarizing color filter, which comprises dyeing a transparent film with a transmittance dye and a dichroic dye and then subjecting the dyed film to monoaxial stretching, the dyeing is conducted, for example, by the following methods:

(a) A transparent film is dyed in a solution containing 0.001-5% of a dichroic dye, at room temperature to 200°C under normal pressure to 10 kg/cm^2 for 1 minute to 1 hour; and the resulting film is also dyed in a solution containing 0.001-5% of a transmittance dye at from room temperature to 200°C under from normal pressure to 10 kg/cm^2 for 1 minute to 1 hour.
(b) A transparent film is dyed with a transmittance dye; and the resulting film is dyed with a dichroic dye.
(c) A transparent film is dyed in 0.001-5% solution of a mixture of a dichroic dye and a transmittance dye, in which the ratio of the two dyes is 1 : 0.01-100, at from room temperature to 200°C under normal pressure to 10 kg/cm^2 for 1 minute to 1 hour.

The dyed film may be monoaxially stretched from 3- to 10-fold at the glass transition temperature (Tg) of the transparent film, whereby a polarizing color filter is obtained.

The stretching may be dry or wet stretching. As necessary, thermofixing by annealing may be conducted. In the stretching of a PVA film, a boric acid treatment is applied during or after the stretching.

The fourth process for producing a color filter; which comprises dyeing a monoaxially stretched film, is conducted as follows: A transparent film such as PVA film, PET film or the like is monoaxially stretched from 3- to 10-fold; then, the stretched film is dyed, suitable by one of the following methods:

(a) The stretched transparent film is dyed in a solution containing 0.001-5% of a dichroic dye, at from room temperature to 200°C under normal pressure to 10 kg/cm^2 for 1 minute to 1 hour; and the resulting film is also dyed in a solution containing 0.001-5% of a transmittance dye at from room temperature to 200°C under from normal pressure to 10 kg/cm^2 for 1 minute to 1 hour.
(b) The stretched transparent film is dyed with a transmittance dye and the resulting dyed film is dyed with a dichroic dye.
(c) The stretched transparent film is dyed in a 0.001-5% solution of a mixture of a dichroic dye and a transmittance dye in which the ratio of the two dyes is 1 : 0.01-100, at from room temperature to 200°C under from normal pressure to 10 kg/cm^2 for 1 minute to 1 hour.

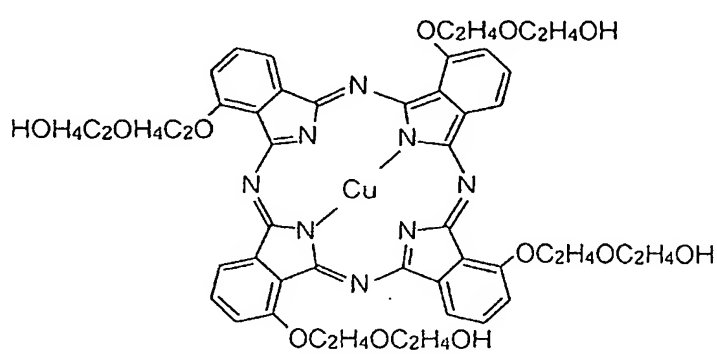
Each solvent used in the above dyeing methods is preferably water or ethylene glycol. Each dye may be dissolved completely or dispersed in each solvent. During the dyeing, there may be added as necessary 0.001-10% of a nonionic or anionic surfactant and 0.001-10% of Glauber's salt or a salt.

In the above descriptions, although the terms "transmittance dye" "dichroic dye" and "resin" are used in the singular, each of them means not only a single substance but also a mixture of two or more substances.

The present invention is specifically described below. However, the present invention is not restricted to these Examples.

Example 1

A red polarizing film (PET type, a product of Mitsui Toatsu Chemicals, Inc.) was coated, by spin coating (1,500 rpm), with a solution of 1 g of a green dye suitable for a color filter (a transmittance dye), represented by formula (1) and 2 g of a yellow dye for a color filter (a transmittance dye), represented by formula (2), dissolved in 200 g of toluene, whereby a green color filter having a polarizability was produced. Pairs of the thus-produced color filters were overlapped with each other so that the respective polarization axes were parallel or at a right angle to each other. The resulting two laminates were measured for absorption spectra simultaneously. The laminate in which the two color filters had their polarization axes in parallel gave a high transmittance at 520-570 nm. Thus, the color filter had excellent performance as a green filter. Further, the color filter exhibited a large dichroic ratio at 520-570 nm and consequently, it had a high polarizing ability.



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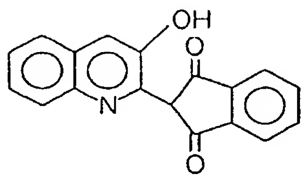
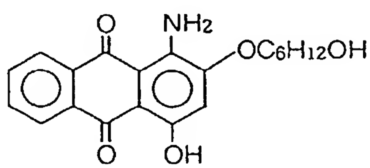


(2)

Example 2

A blue polarizing film (PET type, a product of Nitto Electric Industrial Co., Ltd.) was coated, by spin coating (2,000 rpm), with a solution of 1 g of a red dye for a color filter, represented by formula (3) and 0.5 g of a yellow dye for a color filter, represented by formula (2), dissolved in 200 g of cyclohexanone, whereby a red color polarising filter was produced. Pairs of the thus-produced color filters were overlapped to each other with their polarization axes either parallel or at a right angle to each other. The resulting laminates were measured for absorption spectra simultaneously. The laminate in which the two color filters had their polarization axes in parallel, gave a high transmittance at 620-700 nm. Thus, the color filter had excellent performance as a red filter. Further, the color filter exhibited a large dichroic ratio at 620-700 nm and consequently, it had a high polarizing power.

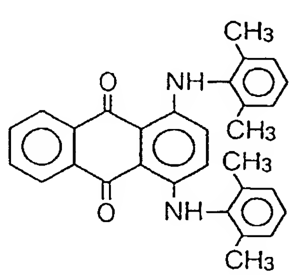


(3)

Example 3

A PVA film was dyed for 5 minutes in a dyeing bath of 2 g of a 1:1 mixture of two dichroic dyes, i.e., C.I. Direct Yellow 12 and C.I. Direct Orange 39 (produced by Nippon Kayaku Co., Ltd., trade name: KAYARUS SUPRA ORANGE 2GL) dissolved in 1 liter of water. The dyed film was stretched 4-fold and dipped in a 5% aqueous boric acid solution for 3 minutes. The resulting film was air-dried at room temperature. Onto the both sides of the dyed, stretched and dried PVA film were overlapped triacetylcellulose (TAC) films as a protective film.

The thus-produced yellow polarizing film was coated, by spin coating (1,800 rpm), with a solution of 1 g of a blue dye for a color filter, represented by formula (4) and 0.5 g of a blue dye for a color filter, represented by formula (5), dissolved in 200 g of toluene, whereby a blue color polarizing filter was produced. Pairs of the thus-produced color filters were overlapped to each other so that the respective polarization axes were parallel or at a right angle to each other. The resulting laminates were measured for absorption spectra simultaneously. The laminate in which the two color filters had their polarization axes in parallel, gave a high transmittance at 420-480 nm. Thus, the color filter had excellent performance as a blue filter. Further, the color filter exhibited a large dichroic ratio at 420-480 nm and consequently, it had a high polarizing ability.



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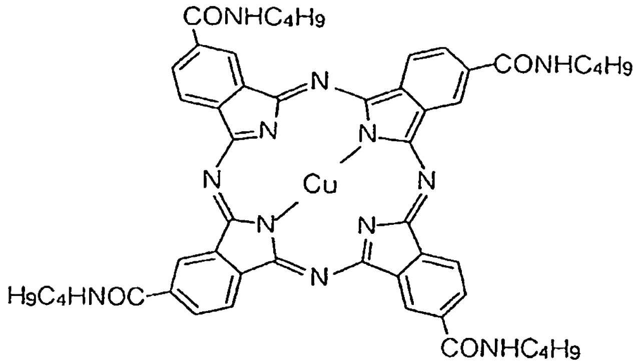
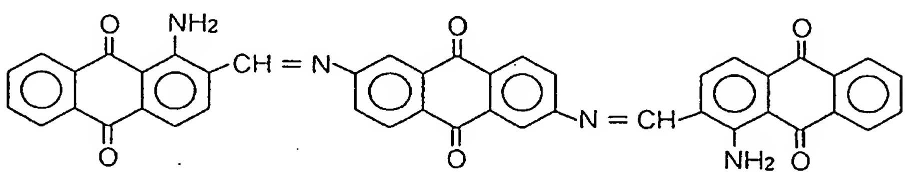


(5)

Example 4

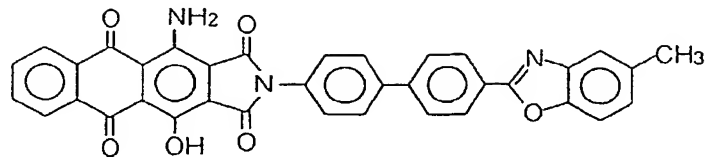
To 1 kg of pellets of a polyethylene terephthalate resin were added 1 g of a green dye for a color filter, represented by formula (1), 2 g of a yellow dye for a color filter, represented by formula (2) and 2 g of a dichroic red dye represented by formula (6). They were uniformly mixed and melt-extruded to prepare a film. The film was stretched 5-fold in the crosswise direction at 80°C using a tenter stretching machine, and then heat-treated at 150°C for 1 minute, whereby a green color polarizing filter was produced. Pairs of the thus-produced color filters were overlapped to each other so that the respective polarization axes became parallel or at a right angle to each other. The resulting two laminates were measured for absorption spectra simultaneously. The laminate in which the two color filters were overlapped so that the polarization axes became parallel, gave a high transmittance at 520-570 nm. Thus, the color filter had excellent performance as a green filter. Further, the color filter exhibited a large dichroic ratio at 52C-570 nm and consequently, it had a high polarizing ability. The color filter, when allowed to stand for 500 hours under the conditions of 80°C and 90% relative humidity, gave substantially no change in color and substantially no reduction in polarizing ability.



(6)

Example 5

To 1 kg of pellets of a polyethylene terephthalate resin were added 1 g of a red dye for a color filter, represented by formula (3), 2 g of a yellow dye for a color filter, represented by formula (2), 1 g of a dichroic blue dye represented by formula (7) and 1 g of a dichroic blue dye represented by formula (8). They were uniformly mixed and melt-extruded to prepare a film. The film was stretched 5-fold in the crosswise direction at 80°C using a tenter stretching machine, and then heat-treated at 150°C for 1 minute, whereby a red color polarizing filter was produced. Pairs of the thus-produced color filters were overlapped to each other so that the respective polarization axes became parallel or at a right angle to each other. The resulting two laminates were measured for absorption spectra simultaneously. The laminate in which the two color filters were overlapped so that the polarization axes became parallel, gave a high transmittance at 620-700 nm. Thus, the color filter had excellent performance as a red filter. Further, the color filter exhibited a large dichroic ratio at 620-700 nm and consequently, it had a high polarizing ability. The color filter, when allowed to stand for 500 hours under the conditions of 80°C and 90% relative humidity, gave substantially no change in color and substantially no reduction in polarizing ability.



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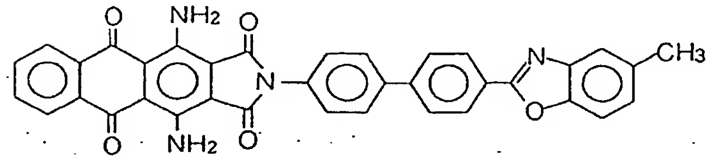
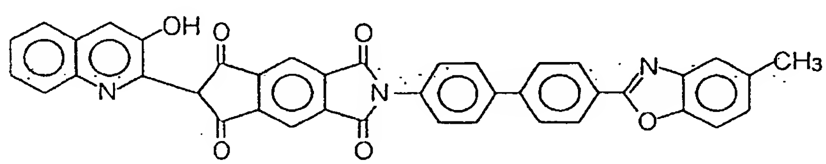


(8)

Example 6

To 1 kg of pellets of a polyethylene terephthalate resin were added 1 g of a blue dye for a color filter, represented by formula (4), 0.5 g of a blue dye for a color filter, represented by formula (5) and 1 g of a dichroic yellow dye represented by formula (9). They were uniformly mixed and melt-extruded to prepare a film. The film was stretched 5-fold in the crosswise direction at 80°C using a tenter stretching machine, and then heat-treated at 150°C for 1 minute, whereby a blue color polarizing filter was produced. Pairs of the thus-produced color filters were overlapped to each other so that the respective polarization axes became parallel or a right angle to each other. The resulting two laminates were measured for absorption spectrums simultaneously. The laminate in which the two color filters were overlapped so that the polarization axes became parallel, gave a high transmittance at 420480 nm. Thus, the color filter had excellent performance as a blue filter. Further, the color filter exhibited a large dichroic ratio at 420-480 nm and consequently, it had a high polarizing ability. The color filter, when allowed to stand for 500 hours under the conditions of 80°C and 90% relative humidity, gave substantially no change in color and substantially no reduction in polarizability.



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Example 7

A PVA film was dyed for 5 minutes in a dyeing bath of 2 g of a 1:1:3 mixture of two dyes for a color filter, i.e., C.I. Reactive Blue 19 and C.I. Reactive Yellow 3 and a dichroic dye, i.e., C.I. Direct Red 81 dissolved in 1 liter of water. The dyed film was stretched 4-fold and dipped in a 5% aqueous boric acid solution for 3 minutes. The resulting film was air-dried at room temperature. Onto both sides of the dyed, stretched and dried PVA film were overlapped triacetylcellulose (TAC) films as a protective film.

Pairs of the thus-produced color filters were overlapped to each other so that the respective polarization axes became parallel or at a right angle to each other. The resulting two laminates were measured for absorption spectra simultaneously. The laminate in which the two color filters were overlapped so that the polarization axes became parallel, gave a high transmittance at 520-570 nm. Thus, the color filter had excellent performance as a green filter. Further, the color filter exhibited a large dichroic ratio at 520-570 nm and consequently, it had a high polarizing ability.

Example 8

A PVA film was dyed for 5 minutes in a dyeing bath of 2 g of a 2:1:1:1 mixture of two dyes for a color filter, i.e., C. I. Reactive Red 6 and C.I. Reactive Yellow 17 and two dichroic dyes, i.e., C.I. Direct Blue 168 and C.I. Direct Blue 202

dissolved in 1 liter of water. The dyed film was stretched 4-fold and dipped in a 5% aqueous boric acid solution for 3 minutes. The resulting film was air-dried at room temperature. Onto the both sides of the dyed, stretched and dried PVA film were overlapped triacetylcellulose (TAC) films as a protective film.

Pairs of the thus-produced color filters were overlapped to each other so that the respective polarization axes became parallel or at a right angle to each other. The resulting two laminates were measured for absorption spectra simultaneously. The laminate in which the two color filters were overlapped so that the polarization axes became parallel, gave a high transmittance at 620-700 nm. Thus, the color filter had excellent performance as a red filter. Further, the color filter exhibited a large dichroic ratio at 620-700 nm and consequently, it had a high polarizing ability.

Example 9

A PVA film was dyed for 5 minutes in a dyeing bath of 2 g of a 1:2:1:2 mixture of two dyes for a color filter, i.e., C. I. Reactive Violet 2 and C.I. Reactive Blue 19 and two dichroic dyes, i.e., C.I. Direct Yellow 12 and C.I. Direct Orange 12 dissolved in 1 liter of water. The dyed film was stretched 4-fold and dipped in a 5% aqueous boric acid solution for 3 minutes. The resulting film was air-dried at room temperature. Onto both sides of the dyed, stretched and dried PVA film were overlapped triacetylcellulose (TAC) films as a protective film.

Pairs of the thus-produced color filters were overlapped to each other so that the respective polarization axes became parallel or at a right angle to each other. The resulting two laminates were measured for absorption spectra simultaneously. The laminate in which the two color filters were overlapped so that the polarization axes became parallel, gave a high transmittance at 420-480 nm. Thus, the color filter had excellent performance as a blue filter. Further, the color filter exhibited a large dichroic ratio at 420-480 nm and consequently, it had a high polarizing ability.

Example 10

A PVA film was stretched 4-fold and then dyed for 5 minutes in a dyeing bath of 2 g of a 1:1:3 mixture of two dyes for a color filter, i.e., C.I. Reactive Blue 19 and C.I. Reactive Yellow 3 and a dichroic dye, i.e., C.I. Direct Red 81 dissolved in 1 liter of water. The dyed film was dipped in a 5% aqueous boric acid solution for 3 minutes. The resulting film was air-dried at room temperature. Onto both sides of the stretched and dried PVA film were overlapped triacetylcellulose (TAC) films as a protective film.

Pairs of the thus-produced color filters were overlapped to each other so that the respective polarization axes became parallel or at a right angle to each other. The resulting two laminates were measured for absorption spectra simultaneously. The laminate in which the two color filters were overlapped so that the polarization axes became parallel, gave a high transmittance at 520-570 nm. Thus, the color filter had excellent performance as a blue filter. Further, the color filter exhibited a large dichroic ratio at 520-570 nm and consequently, it had a high polarizing ability.

Example 11

A PVA film was stretched 4-fold and then dyed for 5 minutes in a dyeing bath of 2 g of a 2:1:1:1 mixture of two dyes for a color filter, i.e., C.I. Reactive Red 6 and C.I. Reactive Yellow 17 and two dichroic dyes, i.e., C.I. Direct Blue 168 and C.I. Direct Blue 202 dissolved in 1 liter of water. The dyed film was dipped in a 5% aqueous boric acid solution for 3 minutes. The resulting film was air-dried at room temperature. Onto both sides of the stretched and dried PVA film were overlapped triacetylcellulose (TAC) films as a protective film.

Pairs of the thus-produced color filters were overlapped to each other so that the respective polarization axes became parallel or at a right angle to each other. The resulting two laminates were measured for absorption spectra simultaneously. The laminate in which the two color filters were overlapped so that the polarization axes became parallel, gave a high transmittance at 620-700 nm. Thus, the color filter had excellent performance as a red filter. Further, the color filter exhibited a large dichroic ratio at 620-700 nm and consequently, it had a high polarizing ability.

Example 12

A PVA film was stretched 4-fold and then dyed for 5 minutes in a dyeing bath of 2 g of a 1:2:1:2 mixture of two dyes for a color filter, i.e., C.I. Reactive Violet 2 and C.I. Reactive Blue 19 and two dichroic dyes, i.e., C.I. Direct Yellow 12 and C.I. Direct Orange 12 dissolved in 1 liter of water. The dyed film was dipped in a 5% aqueous boric acid solution for 3 minutes. The resulting film was air-dried at room temperature. Onto both sides of the stretched and dried PVA film were overlapped triacetylcellulose (TAC) films as a protective film.

Pairs of the thus-produced color filters were overlapped to each other so that the respective polarization axes became parallel or at a right angle to each other. The resulting two laminates were measured for absorption spectra simultaneously. The laminate in which the two color filters were overlapped so that the polarization axes became

parallel, gave a high transmittance at 420-480 nm. Thus, the color filter had excellent performance as a blue filter. Further, the color filter exhibited a large dichroic ratio at 420-480 nm and consequently, it had a high polarizing ability.

Claims

1. A color filter having a capability to polarize light, which comprises a dye having a spectral transmittance subsequently referred to as "transmittance dye", a dichroic dye having a capability to polarize light, and a base resin, wherein the combination of the transmittance dye and the dichroic dye is such that (1) the transmittance dye is red and the dichroic dye is blue for a red color polarizing filter, (2) the transmittance dye is green and the dichroic dye is red for a green color polarizing filter, or (3) the transmittance dye is blue and the dichroic dye is yellow for a blue color polarizing filter.

2. The color filter according to claim 1, wherein at least one of the transmittance dye and the dichroic dye is contained in the base resin.

3. A process for producing a color filter having a capability to polarize light, which comprises coating and fixing a dye having a spectral transmittance subsequently referred to as "transmittance dye" on a monochromatic polarizing film comprising a dichroic dye, wherein the combination of the transmittance dye and the dichroic dye is such that (1) the transmittance dye is red and the dichroic dye is blue for a red color polarizing filter, (2) the transmittance dye is green and the dichroic dye is red for a green color polarizing filter or (3) the transmittance dye is blue and the dichroic dye is yellow for a blue color polarizing filter.

4. A process for producing a color filter having a capability to polarize light, which comprises mixing a dye having a spectral transmittance subsequently referred to as "transmittance dye", a dichroic dye, and a transparent resin, subjecting the mixture to melt extrusion to obtain a film, and subjecting the film to monoaxial stretching; wherein the combination of the transmittance dye and the dichroic dye is such that (1) the transmittance dye is red and the dichroic dye is blue for a red color polarizing filter, (2) the transmittance dye is green and the dichroic dye is red for a green color polarizing filter, or (3) the transmittance dye is blue and the dichroic dye is yellow for a blue color polarizing filter.

5. A process for producing a color filter having a capability to polarize light, which comprises dyeing a transparent film with a dye having a spectral transmittance subsequently referred to as "transmittance dye" and a dichroic dye, and subjecting the dyed film to monoaxial stretching; wherein the combination of the transmittance dye and the dichroic dye is such that (1) the transmittance dye is red and the dichroic dye is blue for a red color polarizing filter, (2) the transmittance dye is green and the dichroic dye is red for a green color polarizing filter, or (3) the transmittance dye is blue and the dichroic dye is yellow for a blue color polarizing filter.

6. A process for producing a color filter having a capability to polarize light, which comprises dyeing a transparent monoaxially stretched film with a dye having a spectral transmittance subsequently referred to as "transmittance dye" and a dichroic dye, wherein the combination of the transmittance dye and the dichroic dye is such that (1) the transmittance dye is red and the dichroic dye is blue for a red color polarizing filter, (2) the transmittance dye is green and the dichroic dye is red for a green color polarizing filter, or (3) the transmittance dye is blue and the dichroic dye is yellow for a blue color polarizing filter.

Patentansprüche

1. Farbfilter mit der Fähigkeit, Licht zu polarisieren, welcher umfaßt: einen Farbstoff mit einer spektralen Durchlässigkeit, nachfolgend als "Durchlässigkeitsfarbstoff" bezeichnet, einen dichroitischen Farbstoff mit der Fähigkeit, Licht zu polarisieren und ein Basisharz, wobei die Kombination des Durchlässigkeitsfarbstoffs und des dichroitischen Farbstoffs derart ist, daß (1) der Durchlässigkeitsfarbstoff rot und der dichroitische Farbstoff blau für einen roten polarisierenden Farbfilter ist, (2) der Durchlässigkeitsfarbstoff grün und der dichroitische Farbstoff rot für einen grünen polarisierenden Farbfilter ist oder (3) der Durchlässigkeitsfarbstoff blau und der dichroitische Farbstoff gelb für einen blauen polarisierenden Farbfilter ist.

2. Farbfilter nach Anspruch 1, wobei mindestens einer von Durchlässigkeitsfarbstoff und dichroitischem Farbstoff im Basisharz enthalten ist.

3. Verfahren zum Herstellen eines Farbfilters mit der Fähigkeit, Licht zu polarisieren, welches umfaßt: Beschichten und Fixieren eines Farbstoffs mit einer spektralen Durchlässigkeit, nachfolgend als "Durchlässigkeitsfarbstoff" bezeichnet, auf einem monochromatisch polarisierenden Film umfassend einen dichroitischen Farbstoff, wobei die Kombination des Durchlässigkeitsfarbstoffs und des dichroitischen Farbstoffs derart ist, daß (1) der Durchlässigkeitsfarbstoff rot und der dichroitische Farbstoff blau für einen roten polarisierenden Farbfilter ist, (2) der Durchlässigkeitsfarbstoff grün und der dichroitische Farbstoff rot für einen grünen polarisierenden Farbfilter ist oder (3) der Durchlässigkeitsfarbstoff blau und der dichroitische Farbstoff gelb für einen blauen polarisierenden Farbfilter ist.

4. Verfahren zum Herstellen eines Farbfilters mit der Fähigkeit, Licht zu polarisieren, welches umfaßt: einen Farbstoff mit einer spektralen Durchlässigkeit, nachfolgend als "Durchlässigkeitsfarbstoff" bezeichnet, einen dichroitischen Farbstoff und ein transparentes Harz mischen, das Gemisch einer Schmelzextrusion unterziehen, um einen Film zu erhalten, und den Film einem monoaxialen Dehnen bzw. Recken unterziehen; wobei die Kombination des Durchlässigkeitsfarbstoffs und des dichroitischen Farbstoffs derart ist, daß (1) der Durchlässigkeitsfarbstoff rot und der dichroitische Farbstoff blau für einen roten polarisierenden Farbfilter ist, (2) der Durchlässigkeitsfarbstoff grün und der dichroitische Farbstoff rot für einen grünen polarisierenden Farbfilter ist oder (3) der Durchlässigkeitsfarbstoff blau und der dichroitische Farbstoff gelb für einen blauen polarisierenden Farbfilter ist.

5. Verfahren zum Herstellen eines Farbfilters mit der Fähigkeit, Licht zu polarisieren, welches umfaßt: einen transparenten Film mit einem Farbstoff mit einer spektralen Durchlässigkeit, nachfolgend als "Durchlässigkeitsfarbstoff" bezeichnet und mit einem dichroitischen Farbstoff färben, und den gefärbten Films einem monoaxialen Dehnen bzw. Recken unterziehen; wobei die Kombination des Durchlässigkeitsfarbstoffs und des dichroitischen Farbstoffs derart ist, daß (1) der Durchlässigkeitsfarbstoff rot und der dichroitische Farbstoff blau für einen roten polarisierenden Farbfilter ist, (2) der Durchlässigkeitsfarbstoff grün und der dichroitische Farbstoff rot für einen grünen polarisierenden Farbfilter ist oder (3) der Durchlässigkeitsfarbstoff blau und der dichroitische Farbstoff gelb für einen blauen polarisierenden Farbfilter ist.

6. Verfahren zum Herstellen eines Farbfilters mit der Fähigkeit, Licht zu polarisieren, welches umfaßt: Färben eines transparenten monoaxial gedehnten bzw. gereckten Films mit einem Farbstoff mit einer spektralen Durchlässigkeit, nachfolgend als "Durchlässigkeitsfarbstoff" bezeichnet und mit einem dichroitischen Farbstoff, wobei die Kombination des Durchlässigkeitsfarbstoffs und des dichroitischen Farbstoffs derart ist, daß (1) der Durchlässigkeitsfarbstoff rot und der dichroitische Farbstoff blau für einen roten polarisierenden Farbfilter ist, (2) der Durchlässigkeitsfarbstoff grün und der dichroitische Farbstoff rot für einen grünen polarisierenden Farbfilter ist oder (3) der Durchlässigkeitsfarbstoff blau und der dichroitische Farbstoff gelb für einen blauen polarisierenden Farbfilter ist.

Revendications

1. Filtre couleur ayant une capacité à polariser la lumière et qui comprend un colorant ayant une transmittance spectrale désignée ci-après "colorant de transmittance", un colorant dichroïque ayant une capacité à polariser la lumière et une résine de base, filtre dans lequel la combinaison du colorant de transmittance et du colorant dichroïque est telle que (1) le colorant de transmittance est rouge et le colorant dichroïque est bleu pour un filtre polarisant de couleur rouge, (2) le colorant de transmittance est vert et le colorant dichroïque est rouge pour un filtre polarisant de couleur verte ou (3) le colorant de transmittance est bleu et le colorant dichroïque est jaune pour un filtre polarisant de couleur bleue.

2. Filtre couleur selon la revendication 1, dans lequel au moins l'un du colorant de transmittance et du colorant dichroïque est contenu dans la résine de base.

3. Procédé pour produire un filtre couleur ayant une capacité à polariser la lumière et qui comprend le revêtement et la fixation d'un colorant ayant une transmittance spectrale désignée ci-après "colorant de transmittance" sur un film polarisant monochromatique comprenant un colorant dichroïque, procédé dans lequel la combinaison du colorant de transmittance et du colorant dichroïque est telle que (1) le colorant de transmittance est rouge et le colorant dichroïque est bleu pour un filtre polarisant de couleur rouge, (2) le colorant de transmittance est vert et le colorant dichroïque est rouge pour un filtre polarisant de couleur verte ou (3) le colorant de transmittance est bleu et le colorant dichroïque est jaune pour un filtre polarisant de couleur bleue.

4. Procédé pour produire un filtre couleur ayant une capacité à polariser la lumière, procédé qui comprend les opé-

rations consistant à mélanger un colorant ayant une transmittance spectrale désignée ci-après "colorant de transmittance", un colorant dichroïque et une résine transparente, à soumettre le mélange à une extrusion par fusion pour obtenir un film et à soumettre le film à un étirement monoaxial; procédé dans lequel la combinaison du colorant de transmittance et du colorant dichroïque est telle que (1) le colorant de transmittance est rouge et le colorant dichroïque est bleu pour un filtre polarisant de couleur rouge, (2) le colorant de transmittance est vert et le colorant dichroïque est rouge pour un filtre polarisant de couleur verte ou (3) le colorant de transmittance est bleu et le colorant dichroïque est jaune pour un filtre polarisant de couleur bleue.

5. Procédé pour produire un filtre de couleur ayant une capacité à polariser la lumière et qui comprend la coloration d'un film transparent avec un colorant ayant une transmittance spectrale désignée ci-après "colorant de transmittance" et un colorant dichroïque et à soumettre le film coloré à un étirement monoaxial ; procédé dans lequel la combinaison du colorant de transmittance et du colorant dichroïque est telle que (1) le colorant de transmittance est rouge et le colorant dichroïque est bleu pour un filtre polarisant de couleur rouge, (2) le colorant de transmittance est vert et le colorant dichroïque est rouge pour un filtre polarisant de couleur verte ou (3) le colorant de transmittance est bleu et le colorant dichroïque est jaune pour un filtre polarisant de couleur bleue.

6. Procédé pour la production d'un filtre couleur ayant une capacité à polariser la lumière qui comprend la coloration d'un film transparent étiré monoaxialement avec un colorant ayant une transmittance spectrale désignée ci-après "colorant de transmittance" et un colorant dichroïque, procédé dans lequel la combinaison du colorant de transmittance et du colorant dichroïque est telle que (1) le colorant de transmittance est rouge et le colorant dichroïque est bleu pour un filtre polarisant de couleur rouge, (2) le colorant de transmittance est vert et le colorant dichroïque est rouge pour un filtre polarisant de couleur verte ou (3) le colorant de transmittance est bleu et le colorant dichroïque est jaune pour un filtre polarisant de couleur bleue.

FIG.1
PRIOR ART

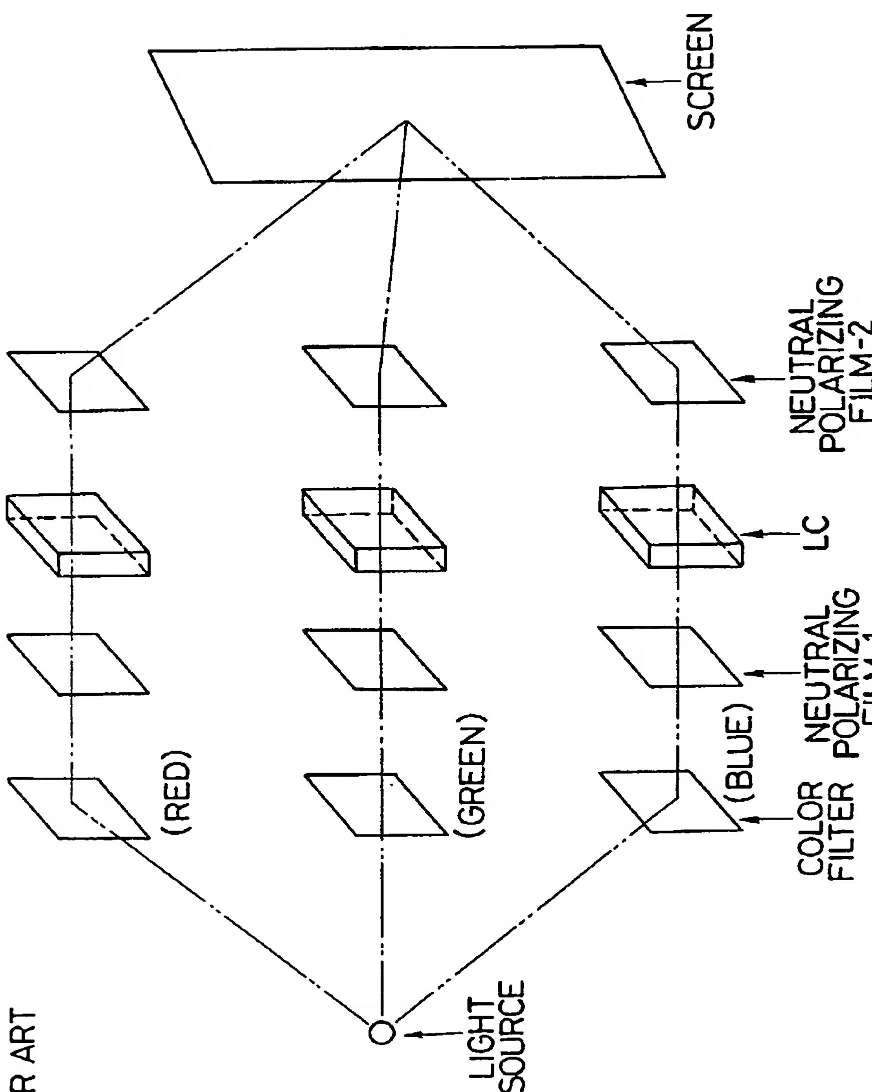


FIG.2

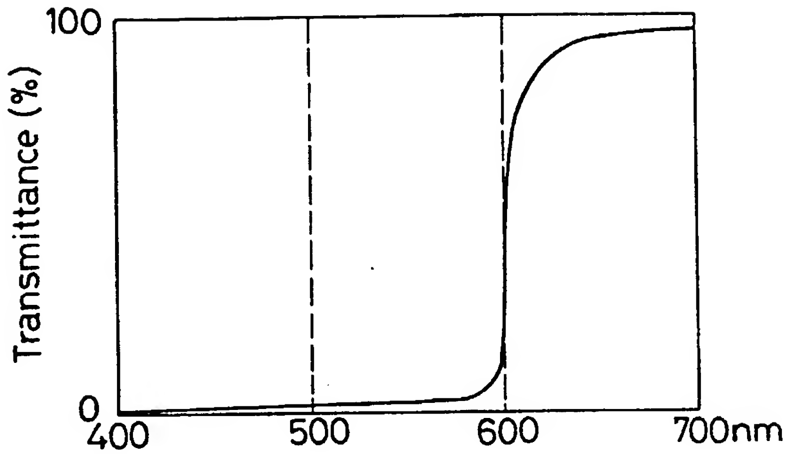

100
Transmittance (%)
0
400
500
600
700nm

FIG.3

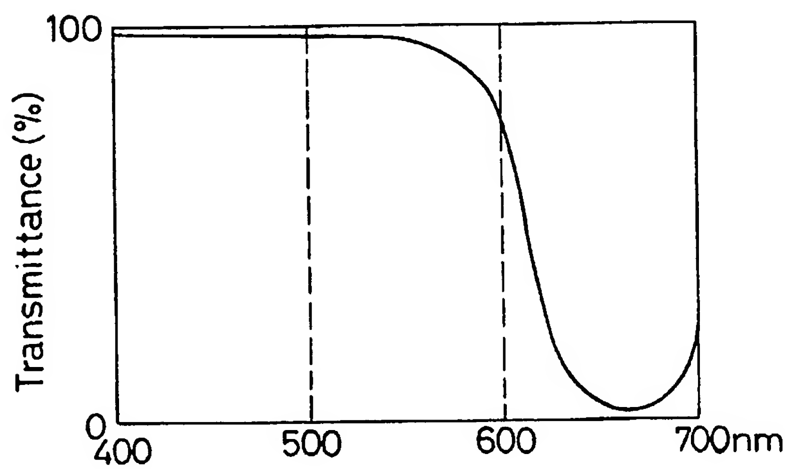

100
Transmittance (%)
0
400
500
600
700nm

FIG.4

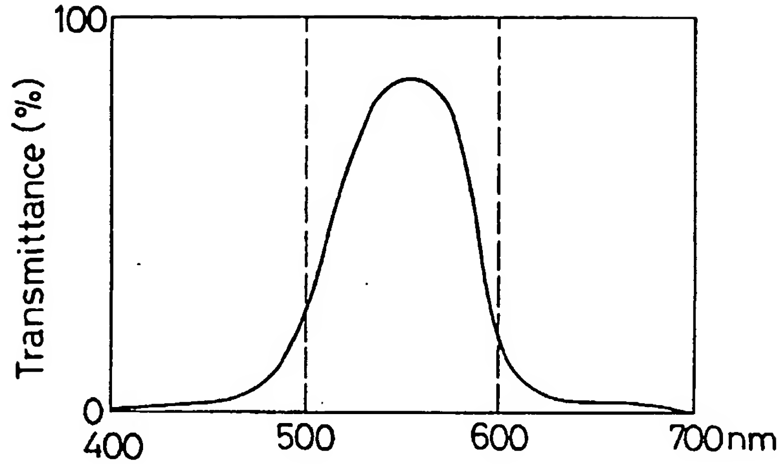

100
Transmittance (%)
0
400
500
600
700nm

FIG.5

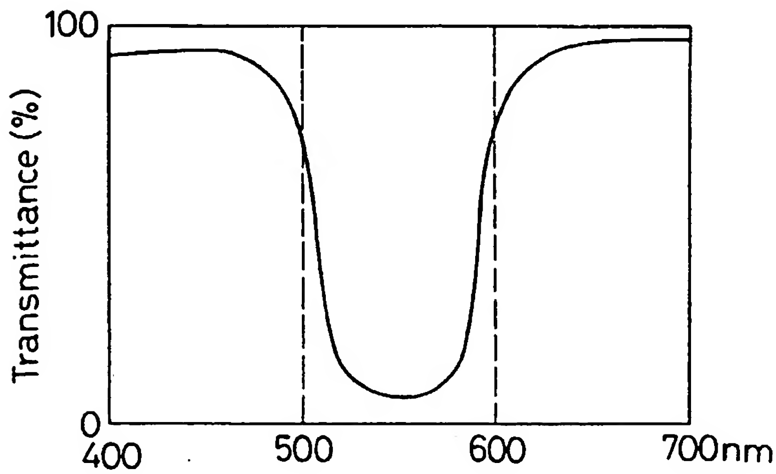

100
Transmittance (%)
0
400
500
600
700nm

FIG.6

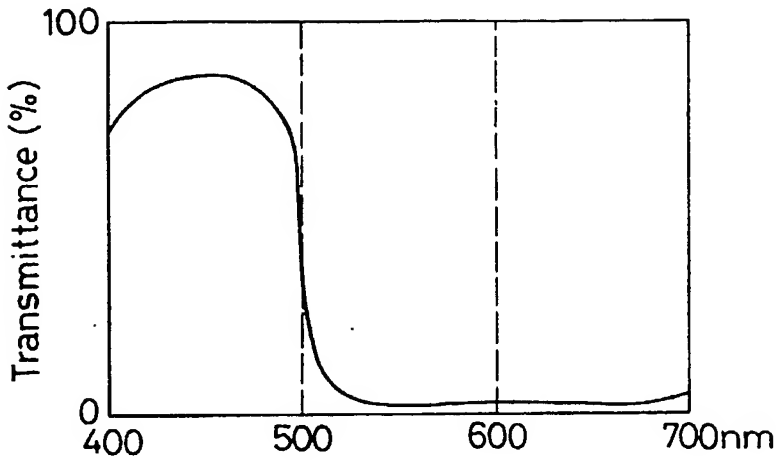
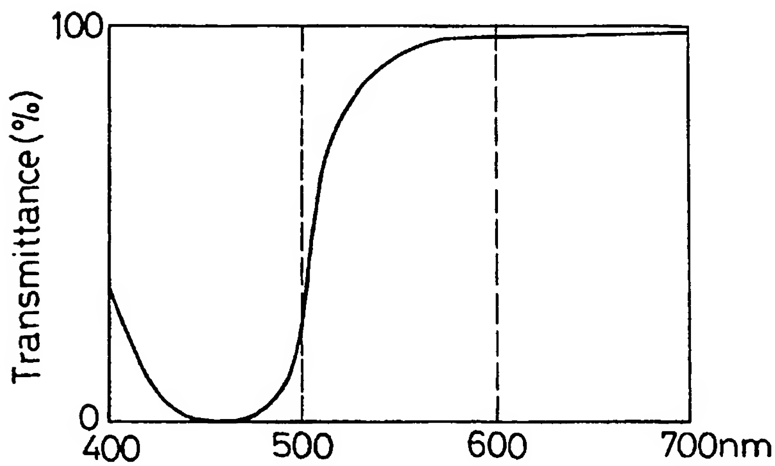

100
Transmittance (%)
0
400
500
600
700nm

FIG.7


100
Transmittance (%)
0
400
500
600
700nm